

#### Remarks:

This phenotype is very common at the locality Kalksburg, Vienna, where it occurs in a poorly consolidated conglomerate with a grain size usually ranging from 2 to 5 mm. Intermediate morphs connecting this form with *campanulatus* (SCHLOTHEIM, 1820), *acuminatus* DESOR in AGASSIZ & DESOR, 1847, *portentosus* MICHELIN, 1861 and to forms determined by earlier workers as *gibbosus* DE SERRES, 1829 and *reidii* WRIGHT, 1855 exist.

LAMBERT (1931) was one of the first to recognise the large variability in this group and synonymised the species *C. confusus* POMEL, 1887, *C. paratinus* POMEL, 1887, *C. bassanii* LOVISATO, 1911, *C. subconoideus* VADÁSZ, 1915, *C. convexus* VADÁSZ, 1915, *C. gracilis* VADÁSZ, 1915 and *C. periplanus* VADÁSZ, 1915 with *C. partschii* MICHELIN, 1861.

In most papers this species is referred to as *partschi*, in contrast to the original spelling *partschii* by MICHELIN (1861). According to the ICZN (4<sup>th</sup> ed., Articles 33.4. and 33.5.) the original spelling is to be used and *partschi* has to be regarded as "incorrect subsequent spelling" (not as emendation) regardless whether the change from -ii to -i was intentional or not.

The record of *C. campanulatus* forma *partschi* from the Ukrainian part of the Carpathian Foredeep by SZÖRÉNYI (1953, as *C. partschi*) is peculiar. *C. campanulatus* was never before or afterwards reported from that region (neither from Poland, nor from the northern Czech Republic). Until confirmed by additional finds this record should be treated with caution (SZÖRÉNYI's material consisted entirely of Museum specimens, it is easily possible that the *C. campanulatus* specimen was accompanied by an erroneous label). The only other species of *Clypeaster* occurring in the Carpathian Foredeep is *C. scillae* which was reported by MAĆZYŃSKA (1993, 1996) from Pińczów and Niechobrz in Poland.

#### forma *acuminatus* DESOR in AGASSIZ & DESOR, 1847

(Fig. 28; Pl. 27; Figs. 1a-c)

- \* v 1847a [*Clypeaster*] *acuminatus* DESOR. – DESOR in AGASSIZ & DESOR: 130 ["moulage en plâtre R.63"]
- v. 1858 [*Clypeaster*] *acuminatus* DESOR. – DESOR: 242
- v. 1861 *Clypeaster acuminatus*, DESOR – MICHELIN: 119-120; pl. 21, figs. a-e
- v 1867 *Clypeaster acuminatus* DES. – STACHE: 143
- 1869 *Clypeaster acuminatus* DESOR. – FUCHS: 194
- v. 1869a *Clyp. acuminatus* DESOR. – LAUBE: 183
- v. 1870 *Clypeaster acuminatus* DESM. – LAUBE: 314
- v. 1871 *Clypeaster acuminatus* DESOR. – LAUBE: 63
- 1877 *Clypeaster acuminatus* DEFR. – KARRER: 170
- v. 1877 *Clypeaster acuminatus* DES. – KARRER: 312
- 1878 *Clypeaster acuminatus* DESOR. – HILBER: 563, 575
- ? 1880 *C.[lypeaster] acuminatus* DESOR. Var. *devians* – SEGUENZA: 54; pl. 5, figs. 2, 2a-b
- 1887b *Clypeaster acuminatus*, DESOR. – KOCH: 264
- 1894 *Clypeaster acuminatus*, DESOR. – LÖRENTHEY: 59
- 1907 *Clypeaster acuminatus* DEFR – SCHAFFER: 28
- v. 1915 *Clypeaster acuminatus* DESOR. – VADÁSZ: 149-150
- # v. 1915 *Clypeaster acuminatus* DES. var. *robustus* VAD. – VADÁSZ: 149-150, fig. 41 [transitional to forma *partschi*]
- 1915 *Clypeaster Gauthieri* LOV. – VADÁSZ: 153-155, figs. 45-46
- ? 1915 *Clypeaster subacutus* POMEL. – VADÁSZ: 161-162
- # v. 1915 *Clypeaster subacutus* POMEL var. *depressus* VAD. – VADÁSZ: 161-162, fig. 53
- # v. 1915 *Clypeaster subconoideus* n. sp. – VADÁSZ: 165-166, figs. 56-57
- # v. 1915 *Clypeaster dacicus* n. sp. – VADÁSZ: 167-168, figs. 58-59
- # 1915 *Clypeaster transylvanicus* n. sp. – VADÁSZ: 170-171, figs. 62-63 [type material lost]
- # 1915 *Clypeaster convexus* n. sp. – VADÁSZ: 178-179,

- figs. 70-71 [type material lost]
- # 1915 *Clypeaster subaltus* n. sp. – VADÁSZ: 181-182, figs. 72-73 [type material lost]
- 1928 *Clypeaster acuminatus* DEFR. – BOBIES: 48
- v. 1928 *Clypeaster acuminatus* DESOR – LAMBERT & JEAN-NET: 189
- 1938 *Clypeaster altus* KLEIN (*Scutum angulare*) 1734, 1778 – POLJAK: 183-184; pl. 6, fig. 2
- 1941 *Clypeaster acuminatus* DESOR. – MEZNERICS: 89-90; pl. 2, fig. 5
- 1942 *Clypeaster acuminatus* DEFR – SCHAFFER: 130
- . 1949 *Clypeaster campanulatus acuminatus* DESOR, 1847. – KALABIS: 49-51, 104-106; pl. 4, figs. 3-5
- ? 1969 *Clypeaster* cf. *acuminatus* COTTEAU – MIHÁLY: 256
- 1969 *Clypeaster reidii* WRIGHT – MITROVIĆ-PETROVIĆ: 127; pl. 6, figs. 1, 1a; pl. 7, fig. 1
- 1984 *Clypeaster* cf. *acuminatus* DESOR – KÓKAY et al.: 288

#### Type-material:

*Clypeaster acuminatus* DESOR in AGASSIZ & DESOR, 1847:

Holotype: collection of MICHELIN, current whereabouts unknown; plaster casts (moulage en plâtre R.63 of AGASSIZ) of the holotype are kept at the Musée d'Histoire Naturelle de Neuchâtel and at the Naturhistorisches Museum Wien (NHMW 1857.Gipsabguss.5)

Locus typicus: Šahy (= Ipoly-Shag), Slovak Republic

Age: Badenian (Langhian-Early Serravallian), Middle Miocene

*Clypeaster acuminatus robustus* VADÁSZ, 1915:

Syntypes: three specimens (MAFI Ech 147, 271, 280; VADÁSZ, 1915: 149-150, fig. 41); Museum of the Hungarian Geological Survey, Budapest

Type area: Globu Craiovei (= Globukrajova), Minișu des Sus (= Felménes), and Slatina-Timiș (= Temes-Szlatina), Romania

Age: Late Badenian (Early Serravallian), Middle Miocene

*Clypeaster dacicus* VADÁSZ, 1915:

Holotype: MAFI Ech 118 (VADÁSZ, 1915: figs. 58-59); Museum of the Hungarian Geological Survey, Budapest

Locus typicus: Gârbova de Sus (= Felső-Orbó), Romania

Age: Late Badenian (Early Serravallian), Middle Miocene

*Clypeaster subacutus depressus* VADÁSZ, 1915:

Holotype: MAFI Ech 122 (VADÁSZ, 1915: fig. 53); Museum of the Hungarian Geological Survey, Budapest

Locus typicus: Gârbova de Sus (= Felső-Orbó), Romania

Age: Late Badenian (Early Serravallian), Middle Miocene

*Clypeaster subconoideus* VADÁSZ, 1915:

Holotype: MAFI Ech 120 (VADÁSZ, 1915: fig. 56-57); Museum of the Hungarian Geological Survey, Budapest

Locus typicus: Gârbova de Sus (= Felső-Orbó), Romania

Age: Late Badenian (Early Serravallian), Middle Miocene

#### Material:

Early Badenian (Langhian) – Letkés, Pest, Hungary

MAFI: 1 specimen [MAFI Ech 131 (referred to *Clypeaster acuminatus* DESOR by VADÁSZ, 1915: 149-150)]

Badenian (Langhian-Early Serravallian) – Kalksburg, Vienna, Austria

NHMW: 1 specimen (NHMW 1904.VIII.85)

Badenian (Langhian-Early Serravallian) – Kemence, Pest, Hungary

NHMW: 1 specimen (NHMW 1865.XXXV.15)

Badenian (Langhian-Early Serravallian) – Perchtoldsdorf, NÖ, Austria

NHMW: 2 specimens (NHMW 1904.VIII.91, A2736)

Badenian (Langhian-Early Serravallian) – Šahy (= Ipoly-Shag), Slovak Republic

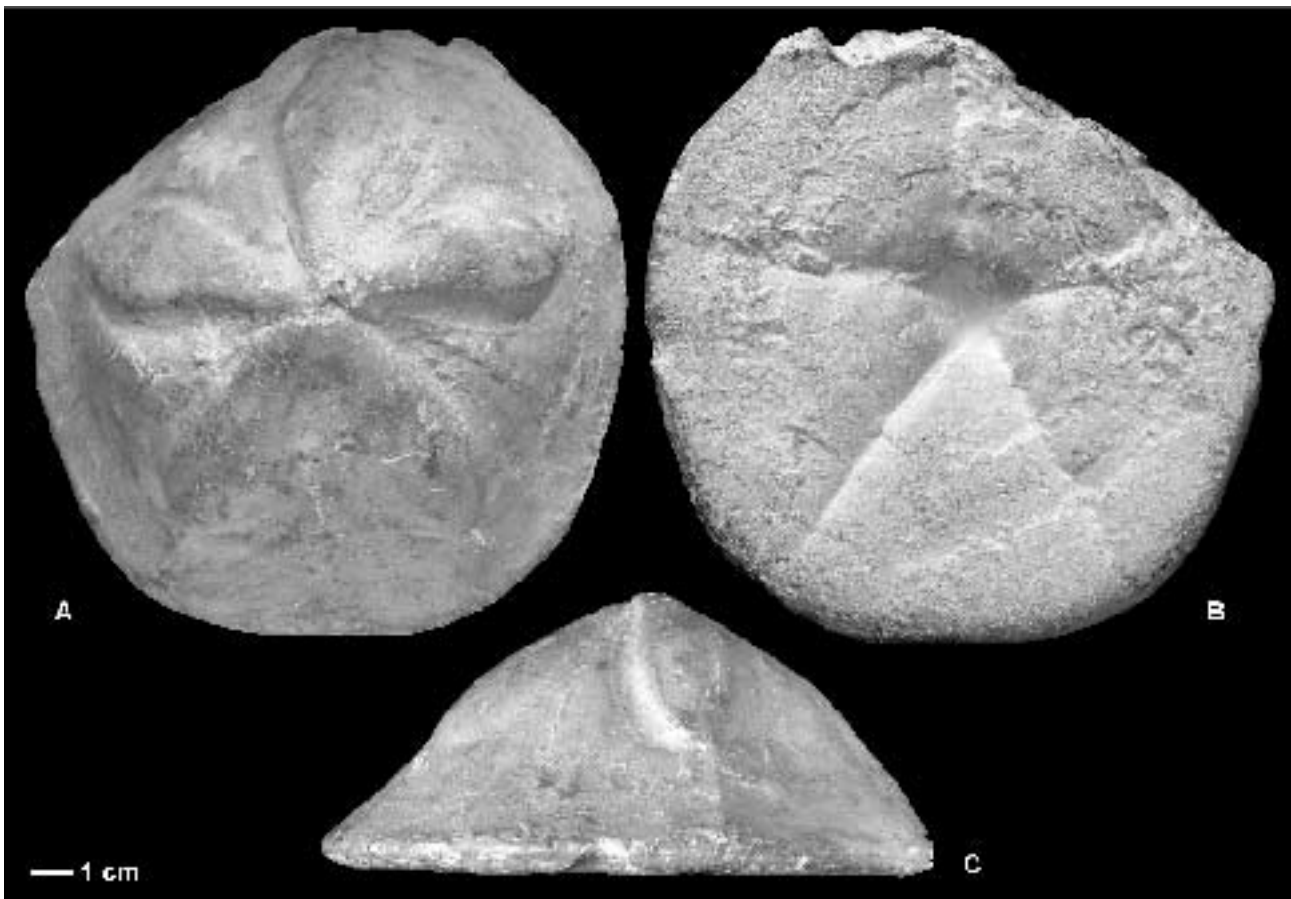


Figure 28: *Clypeaster campanulatus* forma *acuminatus* DESOR in AGASSIZ & DESOR, 1847: plaster cast of the holotype from Kémence, Hungary ("moulage R.63"; NHMW 1857.Gipsabguss.5)

NHMW: 1 plaster cast of the **holotype** [moulage en plâtre R.63] of *Clypeaster acuminatus* Desor in AGASSIZ & DESOR, 1847 (NHMW 1857.Gipsabguss.5)

Late Badenian (Early Serravallian) – Gârbova de Sus (= Felső-Orbó), Romania

MAFI: 3 specimens [MAFI Ech 118 (**holotype** of *Clypeaster dacicus* VADÁSZ, 1915: : 167-168, figs. 58-59), Ech 120 (**holotype** of *Clypeaster subconoideus* VADÁSZ, 1915: 165-166, figs. 56-57), Ech 122 (**holotype** of *Clypeaster subacutus depressus* VADÁSZ, 1915: 162, fig. 53)]

Transitional specimen *acuminatus* DESOR in AGASSIZ & DESOR, 1847 – aff. *reidii* WRIGHT, 1855:

Early Badenian (Langhian) – Letkés, Pest, Hungary

MAFI: 1 specimen [MAFI Ech 233 (**holotype** of *Clypeaster angulatus oblonus* VADÁSZ, 1915: 175-177, fig. 69)]

#### Description:

Characterised by its low-conical profile and its long and broad petals (see Fig. 28). The surface of the petaloid area is more or less flush with the surface outside the petalodium. Test height is moderate and ranges from between 40 to 48 % TL.

#### Remarks:

This phenotype is never very common. A complete series of intermediate morphs connect this form with *partschii* MICHELIN, 1861. Some of these intermediates have been named *C. acuminatus robustus* by VADÁSZ (1915). There are, however, no clear-cut boundaries between this forma, *partschii* (low test height end) and *pyramidalis* (high test height end). Specimens with increasingly flattened adapical area connect this type with

aff. *gibbosus* and aff. *reidii*. As in the former, it is impossible to really separate any well defined units from these series. Except forma *partschii*, which is very common (probably resulting from over-complete sampling of the locality Kalksburg), most of the phenotypes and their intermediates are more or less equally abundant. Therefore it is thought rather unlikely that they represent a complex of cryptic sympatric or hybridising species [as has been suggested for extant species of *Echinocardium* with high haplotype diversity and overlapping morphospace (compare results and hypotheses presented in: LAURIN et al., 1994; WÖRHEIDE, 1995; FÉRAL et al., 1998; CHENULI & FÉRAL, 2003)]. These morphological changes observed in *C. campanulatus* are thus interpreted as environmental signal.

In another group of species (*C. calabrus* – *C. scillae*; see above, respectively below) a similar problem of overlapping morphospace exists. In that group, however, intermediates are rather rare and do not form a continuous series connecting two extremes. Furthermore, individual groups are rather well defined and identification of most specimens is rather straight forward. In that particular case, therefore, an interbreeding species pair seems much more likely.

#### forma aff. *reidii* WRIGHT, 1855

(Pl. 25; Figs. 2a-c)

- 1915 *Clypeaster Reidii* WRIGHT. – VADÁSZ: 145
- 1915 *Cl. Almerai* LAMB. – MÁJER: 35, 88
- 1915 *Cl. angulatus* VAD. – MÁJER: 35, 88
- 1915 *Clypeaster hemisphaericus* n. sp. – VADÁSZ: 168-169, figs. 60-61 [type material lost]

- v ? 1915 *Clypeaster Almerai* LAMB. – VADÁSZ: 173-175, fig. 66
- # v. 1915 *Clypeaster angulatus* n.sp. – VADÁSZ: 175-177, figs. 67-68 [transitional to forma *acuminatus*]
- # v. 1915 *Clypeaster angulatus* VAD. var. *oblongus* VAD. – VADÁSZ: 175-177, fig. 69 [transitional to forma *acuminatus*]
- 1949 *Clypeaster campanulatus reidii* WRIGHT, 1855 – KALABIS: 51-52; 106-109; pl. 5, figs. 1-4
- 1955 *Clypeaster angulatus oblongus* VADÁSZ – TOLLMANN: Tab. 5b
- 1996 *Clypeaster hemisphaericus* VADÁSZ – GHIURCA: 190, unnumbered fig.

**Type-material:**

*Clypeaster angulatus* VADÁSZ, 1915:

Lectotype (designated herein): MAFI Ech 121 (VADÁSZ, 1915: figs. 67-68); Museum of the Hungarian Geological Survey, Budapest

Locus typicus: unclear [label gives no clue; VADÁSZ (1915: 177) lists three localities: Gârbova de Sus (= Felső-Orbó), Romania; Kemence and Letkés, Hungary]

Age: Badenian (Langhian-Early Serravallian), Middle Miocene

*Clypeaster angulatus oblonus* VADÁSZ, 1915:

Holotype: MAFI Ech 233 (VADÁSZ, 1915: fig. 69); Museum of the Hungarian Geological Survey, Budapest

Locus typicus: Letkés, Pest, Hungary

Age: Early Badenian (Langhian), Middle Miocene

**Material:**

Early Badenian (Langhian) – Gombhegy, Kemence, Pest, Hungary

MAFI: 1 specimen [MAFI Ech 237 (specimen strongly damaged; referred to *Clypeaster almerai* LAMB. by VADÁSZ, 1915: 173-175, fig. 66)]

Badenian (Langhian-Early Serravallian) – Gârbova de Sus (= Felső-Orbó) or Kemence or Letkés (Hungary or Romania)

MAFI: 1 specimen [MAFI Ech 121 (syntype of *Clypeaster angulatus* VADÁSZ, 1915: 175-177, fig. 67-68)]

Badenian (Langhian-Early Serravallian) – Kalksburg, Vienna, Austria

NHMW: 2 specimens (NHMW 1890.X.7, 1904.VIII.87)

Badenian (Langhian-Early Serravallian) – Perchtoldsdorf, NÖ, Austria

NHMW: 1 specimen (NHMW 1890.X.8)

Late Badenian (Early Serravallian) – Müllendorf (quarry of the Mühlendorfer Kreidewerke AG), Bgld, Austria

NHMW: 1 specimens (NHMW 1997z0178/1754)

**Description:**

This morphotype is characterised by its high, near hemispherical profile and antero-posteriorly elongated outline. The petaloid area is strongly inflated and slightly larger than in other morphotypes. The surface of the petaloid area is more or less flush with the surface outside the petalodium or forms a very weak angel with it. Test height is moderate and ranges from between 40 to 45 % TL.

**Remarks:**

This phenotype of *C. campanulatus* is very similar (especially in profile view) to *C. reidii* WRIGHT, 1855 from the Messinian of the Maltese Islands. Yet as demonstrated by CHALLIS (1980) *C. reidii* is a junior synonym of *C. altus* LESKE, 1778, a species considered to be different from *C. campanulatus* here. The astonishing similarities in overall test shape, profile and intra-specific variability exhibited could reflect similar responses to environmental factors.

This phenotype is quite rare. Transitional forms connecting this morphotype with *partschii* MICHELIN, 1861, *campanulatus*

(SCHLOTHEIM, 1820) and forms identified as *gibbosus* DE SERRES, 1829 by former authors exist.

**forma aff. *gibbosus* DE SERRES, 1829**

(Pl. 25; Figs. 1a-c)

- v pp 1861 *Clypeaster gibbosus*, MARCEL DE SERRES – MICHELIN: 120-121; pl. 22, figs. a-g; pl. 23, figs. 1a-c
- v pp 1861 *Clypeaster michelotti*, AGASSIZ – MICHELIN: 132 [specimen from Kalksburg]
- 1866b *Clypeaster gibbosus* M. DE SERRES – SUESS: 251
- 1868 *Cl. gibbosus* – KARRER: 570 (footnote)
- 1869 *Clypeaster gibbosus* SERR. – FUCHS: 194
- 1869 *Clypeaster Michelotti* AGASS. – FUCHS: 194
- 1869a *Clyp. gibbosus* RISSO. – LAUBE: 183
- 1870 *Clypeaster gibbosus* MICH. – LAUBE: 314
- 1871 *Clypeaster gibbosus* RISSO sp. – LAUBE: 63-64
- 1877 *Clypeaster gibbosus* RISSO sp. – HILBER: 262
- 1877 *Clypeaster gibbosus* RISSO. – KARRER: 170
- 1877 *Clypeaster gibbosus* SERR. – KARRER: 312
- 1877 *Clypeaster Michelotti* AGASS. – KARRER: 312
- 1887b *Clypeaster* cfr. *gibbosus*, RISSO sp. – KOCH: 265
- 1894 *Clypeaster* cfr. *gibbosus*. RISSO – LÖRENTHEY: 59
- 1907 [*Clypeaster*] *gibbosus* RISSO – SCHAFFER: 28
- v pp 1915 *Clypeaster campanulatus* SCHLOTH. sp. – VADÁSZ: 144-145 [MAFI Ech 236]
- v 1915 *Clypeaster delagadoi* LOR. – VADÁSZ: 146-147; figs. 38-39
- 1928 *Clypeaster gibbosus* RISSO. – BOBIES: 48
- 1942 [*Clypeaster*] *gibbosus* RISSO – SCHAFFER: 130

**Material:**

Early Badenian (Langhian) – Gamlitz (Unterer Gnaser Bruch), near Ehrenhausen, Styria, Austria

NHMW: 1 specimen (NHMW 1868.I.Anhang.1)

Badenian (Langhian-Early Serravallian) – Kalksburg, Vienna, Austria

NHMW: 3 specimens (NHMW 1857.38.23, 1904.VIII.72, 1904.VIII.88)

Late Badenian (Early Serravallian) – Gârbova de Sus (= Felső-Orbó), Romania

MAFI: 1 specimen [MAFI Ech 236 (referred to *Clypeaster campanulatus* SCHLOTH. by VADÁSZ, 1915: 144-145)]

Late Badenian (Early Serravallian) – Kishajmás, Baranya, Hungary

MAFI: 1 specimen [MAFI Ech 235 (referred to *Clypeaster delagadoi* LOR. by VADÁSZ, 1915: 146-147; figs. 38-39)]

**Description:**

This morphotype is very similar to *C. campanulatus* forma aff. *reidii* WRIGHT, 1855 and is also characterised by a strongly inflated petaloid area. In aff. *gibbosus*, however, the test is flattened adapically and somewhat lower. The test is trapezoidal in profile. Test height is moderate and ranges from between 30 to 35 % TL.

**Remarks:**

*C. gibbosus* DE SERRES, 1829 is rather poorly known, the original description is insufficient (as stated already by DESOR, 1858). The re-description and excellent illustrations by MICHELIN (1861; partly based on the specimens considered here), which at least in part, are based on the type material of *C. gibbosus* have been questioned by subsequent authors. LAMBERT (1912: 99; 1913a: 117) pointed out that the descriptions of DE SERRES and MICHELIN contradict each other and suggested that there was some confusion of the type material. Unfortunately he was unable to trace the type material. Thus the question whether MICHELIN's description corresponds to the species of DE SERRES or not remains open.

**forma *pyramidalis* MICHELIN, 1861**

(Pl. 24; Figs. 1-2)

- \* v. 1861 *Clypeaster pyramidalis*, MICHELIN – MICHELIN: 124-125; pl. 27, figs. a-e
- v. 1869 *Clypeaster pyramidalis* MICHEL. – FUCHS: 194
- v. 1869a *Clyp. pyramidalis* MICHELIN. – LAUBE: 183
- v. 1870 *Clypeaster pyramidalis* MICH. – LAUBE: 314
- v. 1871 *Clypeaster pyramidalis* MICHELIN. – LAUBE: 64
- v. 1877 *Clypeaster pyramidalis* MICH. – KARRER: 312
- ? 1880 *C.[lypeaster] pyramidalis* MICHELIN. – SEGUENZA: 54
- 1880 *C.[lypeaster] pyramidalis* MICHELIN – SEGUENZA: 86; pl. 9, figs. 1, 1a
- 1880 *C.[lypeaster] pyramidalis* MICHELIN Var. *brevior* – SEGUENZA: 86; pl. 9, figs. 1b-c
- 1880 *C.[lypeaster] portentosus* DES MOULINS Var. *elattior* – SEGUENZA: 86; pl. 9, fig. 3
- 1887b *Clypeaster pyramidalis*, MICHELIN. – KOCH: 265
- 1894 *Clypeaster pyramidalis* MICHELIN. – HILBER: 394
- 1915 *Cl. hungaricus* VAD. var. *dispar* VAD. – MÁJER: 35, 88
- ? 1915 *Clypeaster hungaricus* n. sp. – VADÁSZ: 155-157; fig. 47-48
- # ? v. 1915 *Clypeaster hungaricus* var. *dispar*. – VADÁSZ: 155-156
- # ? 1915 *Clypeaster Seguenzai* n. nom. – VADÁSZ: 158-159, figs. 49-50 [reference material lost]
- # 1915 *Clypeaster magnus* n. sp. – VADÁSZ: 160-161, figs. 51-52 [type material lost]
- ? 1931 *Clypeaster pyramidalis* MICHELIN. – LAMBERT: 45-46
- 1938a *Clypeaster portentosus* DESM. var. *pyramidalis* MICHELIN – KALABIS: 3, 6, 9, 11
- 1938 *Clypeaster pyramidalis* MICHELIN 1861 – POLJAK: 187; pl. 7, figs. 1-2
- 1941 *Clypeaster pyramidalis* MICHELIN. – MEZNERICS: 89; pl. 2, fig. 8; pl. 3, fig. 5 [transitional between forma *acuminatus* and forma *pyramidalis*]
- ? 1955 *Clypeaster* aff. *seguenzai* VADAS – TOLLMANN: Tab. 5b
- 1969 *Clypeaster turritus* PHIL. – MITROVIĆ-PETROVIĆ: 132-133; pl. 17, fig. 2; pl. 19; figs. 1, 1a
- 1984 *Clypeaster pyramidalis* MICHELIN – MITROVIĆ-PETROVIĆ: 226-227; pl. 6, figs. 1, 1a; pl. 7, fig. 1
- 1984 *Clypeaster Lamberti* LOVISATO – MITROVIĆ-PETROVIĆ: 227-228; pl. 7, figs. 2, 2a; pl. 8, fig. 1
- 1984 *Clypeaster malladai* LAMBERT – MITROVIĆ-PETROVIĆ: 228-229; pl. 8, fig. 2; pl. 9, fig. 1, 1a
- 1984 *Clypeaster gustavi* LOVISATO – MITROVIĆ-PETROVIĆ: 231; pl. 11, figs. 1, 1a-b
- 1984 *Clypeaster subacutus depressus* VADASZ – MITROVIĆ-PETROVIĆ: 232; pl. 12, figs. 2, 2a

**Type-material:**

*Clypeaster pyramidalis* MICHELIN, 1861:

Holotype: NMHW 1843.LIII.1 (MICHELIN, 1861: pl. 27, figs. a-e); Naturhistorisches Museum Wien

Locus typicus: Mitterberg near Baden, NÖ, Austria

Age: Badenian (Langhian-Early Serravallian), Middle Miocene

*Clypeaster hungaricus dispar* VADÁSZ, 1915:

Holotype: MAFI Ech 145 (VADÁSZ, 1915: 156); Museum of the Hungarian Geological Survey, Budapest

Locus typicus: Gombhegy, Kemence, Pest, Hungary

Age: Early Badenian (Langhian), Middle Miocene

**Material:**

Early Badenian (Langhian) – Leibnitz, Styria, Austria

NHMW: 1 specimen (NHMW 1905.VII.10)

Early Badenian (Langhian) – Rauchstallbrunngraben, near Baden, NÖ, Austria

NHMW: 2 specimens (NHMW 1904.VIII.83, 1904.VIII.89)

? Early Badenian (Langhian) – Kemence (Gombhegy), Pest, Hungary

MAFI: 1 specimen {MAFI Ech 145 [holotype of *Clypeaster hungaricus dispar* VADÁSZ, 1915: 156; specimen extremely similar to these classified as *pyramidalis* and *portentosus* by MICHELIN (1861)]}

Badenian (Langhian-Serravallian) – Mitterberg, near Baden, NÖ, Austria

NHMW: 1 specimen [NHMW 1843.LIII.1 (holotype of *C. pyramidalis* MICHELIN, 1861)]

**Description:**

Characterised by its high, conical profile. The petaloid area, like in aff. *reidii*, is slightly larger than in other phenotypes, but otherwise there are few differences. Test height is high and ranges from between 47 to 57 % TL.

**Remarks:**

The original description was based on a single specimen which is still housed at the Naturhistorisches Museum Wien. In the meantime a few additional specimens have been collected. These show that test height (the sole feature distinguishing this form from forma *acuminatus* and forma *portentosus*) is quite variable. This form is connected by transitional morphs with *acuminatus* and *portentosus* and via these formae with the remaining formae of *C. campanulatus*.

**forma *portentosus* MICHELIN, 1861**

(Pl. 22; Figs. 2-3)

- ? 1829 *Clypeaster altus*. LAMARCK. C. I. – DE SERRES: 157 [fide DES MOULINS, 1837; no description or illustration]
- ? 1837 *C.[lypeaster] portentosus*. Nob. – DES MOULINS: 64 [nomen nudum]
- \* v pp 1861 *Clypeaster portentosus*, DES MOULINS – MICHELIN: 125-126; pl. 28, figs. a-e
- # v pp 1861 *Clypeaster alticostatus*, MICHELIN – MICHELIN: 126-127; pl. 29, figs. a, b
- v. 1869a *Clyp. portentosus* DESMOULINS. – LAUBE: 183
- ? 1870 *Clypeaster alticostatus* MICH. – LAUBE: 314
- v. 1871 *Clypeaster portentosus* DESMOULINS. – LAUBE: 64
- ? 1871 *Clypeaster alticostatus* MICHELIN. – LAUBE: 64
- 1877 *Clypeaster alticostatus* MICH. – KARRER: 170
- ? 1879 *Clypeaster portentosus*, DESMOULIN. – HERMITE: 239
- ? 1880 *C.[lypeaster] alticostatus* MICHELIN – SEGUENZA: 87
- ? 1891 *Clypeaster alticostatus*, MICHELIN, 1861 ? – PÉRON & GAUTHIER in COTTEAU, PÉRON & GAUTHIER: 210-213
- ? 1906a *Clypeaster alticostatus* MICHELIN, 1861 – LAMBERT: 88
- 1907 [*Clypeaster*] *alticostatus* MICH. – SCHAFFER: 28
- 1928 *Clypeaster alticostatus* MICH. – BOBIES: 48
- 1936 *Clypeaster alticostatus* MICH. – PAUCĀ: 143
- 1938a *Clypeaster portentosus* DESM. var. *alticostatus* MICHELIN – KALABIS: 3, 5, 8-9, 11
- ? 1938 *Clypeaster alticostatus* MICHELIN 1861 – POLJAK: 184-185
- 1938 *Clypeaster portentosus* DESMOULINS 1837 – POLJAK: 187-188
- 1942 [*Clypeaster*] *alticostatus* MICH. – SCHAFFER: 130
- ? 1970 *Clypeaster portentosus* – MARCOPOULOU-DIACANTONI: 261; pl. 24, figs. 1, 4

### Type-material:

#### *Clypeaster alticostatus* MICHELIN, 1861:

Syntype: NHMW 2003z0055/0001 from the Early Badenian (Langhian) of Rauchstallbrunngraben, near Baden (NÖ, Austria), figured by MICHELIN (1861: pl. 29, figs. a, b); Naturhistorisches Museum Wien

Remarks: Albeit the present specimen is the figured specimen of MICHELIN it is not chosen as lectotype since it is very poorly preserved (MICHELIN's figure is strongly reconstructed). MICHELIN mentioned additional syntypes from Santa Manza in Corsica, which are probably better suited for a lectotype designation, but could not be located.

#### *Clypeaster portentosus* MICHELIN, 1861:

Syntype: NHMW 1846.37.960; Naturhistorisches Museum Wien

Locus typicus: Eisenstadt, Bgld, Austria

Age: Badenian (Langhian-Early Serravallian), Middle Miocene  
Remarks: Specimen accompanied by a hand-written label of MICHELIN, proving that this species was a syntype. The figured specimen could not be located.

### Material:

Early ? Badenian (Langhian) – Rauchstallbrunngraben, near Baden, NÖ, Austria

NHMW: 6 specimens [NHMW 1904.VIII.90, 1978/2040/1, 1978/2040/10, 2003z0055/0001 (syntype of *C. alticostatus* MICHELIN, 1861), 2003z0055/0002, 1890.X.2 (specimen labelled as Kalksburg but preservation and attached sediment suggest the locality Rauchstallbrunngraben)]

Badenian (Langhian-Early Serravallian) – Baden, NÖ, Austria  
NHMW: 1 specimen (NHMW 2003z0054/0001)

Badenian (Langhian-Early Serravallian) – Eisenstadt, Bgld, Austria

NHMW: 1 specimen (NHMW 1846.37.960 [syntype of *C. portentosus* MICHELIN, 1861])

### Description:

Characterised by its highly raised petaloid area and conical to bell-shaped profile, intermediate in shape between *pyramidalis* and *campanulatus*. Test height is about 50 % of TL.

### Remarks:

*C. portentosus* DES MOULINS, 1837 was established by indication to *C. altus* in DE SERRES (1829). In DE SERRES'S work, however, there is no description or illustration. Thus the species cannot be regarded as validly established by indication. Therefore the name *C. portentosus* DES MOULINS, 1837 is a *nomen nudum*. MICHELIN (1861) is the next author who gives a description. Therefore according to the ICZN the species has to be attributed to MICHELIN. AGASSIZ & DESOR (1847a: 130) mention this species in the synonymy of *C. altus* LESKE, but give no description and DESOR (1858: 240) regards it as probable synonym of *C. turritus* AGASSIZ. Thus both cannot be considered as valid authors for this species.

Part of the type material (including the figured specimen) of *Clypeaster alticostatus* MICHELIN, 1861 is kept at the Naturhistorisches Museum Wien. The figured specimen is very poorly preserved (see Pl. 22, Figs. 3a-b) and belongs to the forma discussed here (*portentosus*). Thus, until the remaining type material (originally in the MICHELIN collection) of *C. alticostatus* is located and described *C. alticostatus* has to be considered a *nomen dubium*.

### Occurrence:

Austria: Early to Late Badenian (Langhian-Early Serravallian)

Vienna Basin: Bad Fischau, NÖ (LAUBE, 1869a, 1871; KALABIS, 1938a); Bad Vöslau (MICHELIN, 1861; LAUBE, 1869a, 1871; [NHMW]); Baden (WALCH, 1771; KNORR, 1771;

QUENSTEDT, 1875; KARRER, 1868); Brunn am Steinfeld, NÖ (LAUBE, 1869a, 1871; [NHMW]); Gainfarn, NÖ (KROH, 2002b; [NHMW]); Hundsheim Hill, Hainburg an der Donau, NÖ (STACHE, 1867; [NHMW]); Kalksburg, Vienna (MICHELIN, 1861; SUESS, 1866b; KARRER, 1868; FUCHS, 1869; LAUBE, 1869a, 1871; KARRER, 1877; SCHAFFER, 1907; KALABIS, 1937a, 1938a; SCHAFFER, 1942; [NHMW]); Mannersdorf (KALABIS, 1938a); Mitterberg (= Mittenberg) near Baden, NÖ (MICHELIN, 1861; LAUBE, 1869a, 1871; [NHMW]); Müllendorf (Mühlendorfer Kreide AG quarry), Bgld (KAPOUNEK, 1929; TOLLMANN, 1955); Perchtoldsdorf, NÖ (KALABIS, 1938a; [NHMW]); Rauchstallbrunngraben, near Baden, NÖ (MICHELIN, 1861; SUESS, 1866b; LAUBE, 1869a, 1871; KARRER, 1877; pp GREGORY, 1891; SCHAFFER, 1907; BOBIES, 1928; KALABIS, 1938a; SCHAFFER, 1942; [NHMW]); Rodaun, Vienna (KARRER, 1868); Steinebrunn (formerly Steinabrunn), NÖ (KALABIS, 1938a; [NHMW]); Vienna (QUENSTEDT, 1875); Wallersdopff (probably misspelling of Wöllersdorf), near Baden, NÖ (MICHELIN, 1861); Wiener Neustadt, NÖ (MICHELIN, 1861); Wöllersdorf, NÖ (SUESS, 1866b; KARRER, 1868; LAUBE, 1869a, 1871)

Eisenstadt-Sopron Basin: Eisenstadt, Bgld (MICHELIN, 1861; LAUBE, 1871; pp GREGORY, 1891; [NHMW])

Styrian Basin: Gamlitz, Styria ([NHMW]); Kainberg, Styria (HILBER, 1878); Leibnitz, Styria ([NHMW]); Retznei, near Ehrenhausen, Styria (SCHOUPE, 1949); Weinleiten, near Gamlitz, Styria (HILBER, 1877); between Wiesfleck and Schreibersdorf, Bgld (HILBER, 1894)

Paratethys (non-Austrian occurrences): Early to Late Badenian (Langhian-Early Serravallian)

Molasse Zone: Mušlov, Czech Republic (KALABIS, 1938a); Židlochovice (= Selowitz), Moravia, Czech Republic (QUENSTEDT, 1875); Znojmo, Czech Republic (KALABIS, 1938a)

Vienna Basin: Devínska Nová Ves, Slovak Republic (KALABIS, 1938b, 1949); Kinberk (= Kienberg), near Mikulov, Czech Republic (KALABIS, 1938a, 1949); Mikulov, Czech Republic (KALABIS, 1937a, 1938a, 1949; HARZHAUSER et al., 2004)

Great Hungarian Basin (Pannonian Basin): Alsóbold (=Alsó-Told), Nógrád, Hungary (VADÁSZ, 1915; [MAFI]); Biatorbágy (= Bia), Pest, Hungary (VADÁSZ, 1915; [MAFI]); Budapest, Pest, Hungary (KÓKAY et al., 1984); Budapest Rákos, Pest, Hungary (VADÁSZ, 1906); Budapest-Budatétény (= Tétény), Hungary (VADÁSZ, 1915); Hidasd, Baranya, Hungary (VADÁSZ, 1915); Kemence, Pest, Hungary (MICHELIN, 1861; LAUBE, 1869a, 1871; MÁJER, 1915; VADÁSZ, 1915; [MAFI]; [NHMW]); Kemence (Sámsonháza Fm., Gomb-Hill), Pest, Hungary (MIHÁLY, 1990; [MAFI]); Kishajmás, Baranya, Hungary (VADÁSZ, 1915; [MAFI]); Kovácsszénnája (= Kovacéna), Baranya, Hungary (VADÁSZ, 1915); Mátraverebély, Nógrád, Hungary (MEZNERICS, 1941); Mátraszőlös, Nógrád, Hungary (MEZNERICS, 1941); Letkés, Pest, Hungary (VADÁSZ, 1915; [MAFI]); Lunkavica, Romania (VADÁSZ, 1915; [MAFI]); Nagypall, Baranya, Hungary (VADÁSZ, 1915); Pécs, Baranya, Hungary (VADÁSZ, 1915); Šahy (= Ipoly-Shag), Slovak Republic (DESOR in AGASSIZ & DESOR, 1847a; DESOR, 1858; LAMBERT & JEANNET, 1928; [NHMW]); Sámsonháza, Nógrád, Hungary (VADÁSZ, 1915); Várpalota (Bánta-pusztá), Veszprém, Hungary (VADÁSZ, 1915);

Fore-Carpathian Basin: Krekhiv (= Krehov, = Krehów), near Rawa Ruska, western Ukraine (SZÖRÉNYI, 1953; record based on a single specimen, never reported again from the Carpathian Foredeep)

Transylvanian Basin: Armeniş (= Örményes), Romania (VADÁSZ, 1915; [MAFI]); Buciumi, Romania (GHIURCA, 1996); Cacovalerii (= Cacova, = Kákova), Romania (KOCH, 1887b); Cricău (= Krakkó), Romania (KOCH, 1887b); Gârbova (= Szász-Orbó), Romania (VADÁSZ, 1915); Gârbova de Sus (= Felső-Orbó), Romania (KOCH, 1887b; VADÁSZ, 1915);

[MAFI]; Globu Craiovei (= Globukrajova), Romania (VADÁSZ, 1915; [MAFI]); Livezile (= Vláháza), Romania (VADÁSZ, 1915); Lugoj, Romania [NHMW]; Minişu des Sus (= Felménes), Arad, Romania (VADÁSZ, 1915; [MAFI]); Pietroasa (= Csegez), Romania (ROTH VON TELEGD, 1899; VADÁSZ, 1915); Rachis (= Oláh-Rákos), Romania (KOCH, 1887b; LÖRENTHEY, 1894; VADÁSZ, 1915); Slatina-Timiş (= Temes-Szlatina), Romania (VADÁSZ, 1915; [MAFI]); region E of Taşad, Romania (PAUCĂ, 1936)  
Zala, Sáva and Dráva Basins: Baćin Dol, Cepeliš Brijeg, Giznik, Glogovica, ? Ostrožin, Samobor, Utinje Potok and Zrinj, Croatia (POLJAK, 1938); Derventa, Gradačac, Kozare, Maglajc-Poljane and Ugljevik, Bosnia & Herzegovina (MITROVIĆ-PETROVIĆ, 1969)

Mediterranean\*: Middle (?) Miocene

Agean Sea: ? region Ano Assites Malévysiou, Hiraklion, Creta (MARCOPOULOU-DIACANTONI, 1970)

\* This species is probably much more widespread in the Mediterranean. However, the large number of nominal *Clypeaster* species and the taxonomic mess in this genus prevented me from getting a clear picture on the distribution of this species in the Mediterranean without re-examining the Mediterranean specimens.

### *Clypeaster folium* AGASSIZ in AGASSIZ & DESOR, 1847

(Fig. 29; Pl. 27, Figs. 2a-c)

- ? 1829 *Clypeaster scutellatus* Nobis. – DE SERRES: 157 (fide LAMBERT & JEANNET, 1928: 179)
- \* 1847a [*Clypeaster*] *Folium* AGASS. – AGASSIZ & DESOR: 131, S61.
- pp 1858 [*Clypeaster*] *Folium* AGASS. – DESOR: 243
- . 1861 *Clypeaster folium*, AGASSIZ – MICHELIN: 139; pl. 20, figs. 2a-d
- # 1887 *Clypeaster subfolium* – POMEL: 184 (fide LAMBERT & THIÉRY, 1914: 309)
- 1887b *Clypeaster* cfr. *folium*, AGASSIZ. – KOCH: 265-266; pl. 5, figs. 2a-c, 3a-b, 4
- # 1887b *Clypeaster Herepeyi*, nov. sp. – KOCH: 266-268; pl. 5, figs. 5a-c
- ? 1891 *Clypeaster folium*, AGASSIZ, 1847. – COTTEAU et al.: 164-165
- ? 1891 *Clypeaster subfolium*, POMEL, 1887. – COTTEAU et al.: 165-167
- # 1895 *Clypeaster Lovisatoi*, COTTEAU, 1893 – COTTEAU: 26, pl. 4, figs. 1-2 (fide LAMBERT, 1907a: 48)
- 1910 *Clypeaster Lovisatoi* – LOVISATO: 137-140; pl. 18 (3), fig. 3
- . 1915 *Clypeaster folium* AG. – VADÁSZ: 195-196; fig. 85
- v. 1915 *Clypeaster subfolium* POM. – VADÁSZ: 196-197; fig. 86-88
- # 1915 *Clypeaster sublaganoides* n.sp. – VADÁSZ: 198; fig. 89; pl. 5, fig. 5 [type material lost]
- ? 1915 *Clypeaster folium* AG. – VADÁSZ: 198-199; fig. 90
- 1935 *Clypeaster subfolium* POM. – KALABIS: 276; figs. 2a-b [x-ray image]
- ? non 1937c *Clypeaster subfolium* POM. – KALABIS: 200; fig. 1 [x-ray]
- 1937c *Clypeaster subfolium* POM. – KALABIS: 200; fig. 2 [x-ray]
- ? 1938 *Clypeaster beaumonti* SISMONDA 1841 – POLJAK: 191; pl. 5, fig. 2
- ? 1958 *Clypeaster folium* AGASSIZ – IMBESI SMEDILE: 32-33; pl. 11, figs. 3, 3a-b
- 1960 *Clypeaster folium* AG. nov. ssp. – SOMOS & KÓKAY: 342-343, 346-347; pl. 17, fig. 2.

- 2001 *Clypeaster marginatus* LAMARCK, 1816 – MIKUŽ & MITROVIĆ-PETROVIĆ: 54-55; pl. 3, figs. 1, 1a; pl. 4, figs. 3, 3a; pl. 5, figs. 1, 1a
- 2001 *Clypeaster folium* AGASSIZ, 1847 – MIKUŽ & MITROVIĆ-PETROVIĆ: 55-56; pl. 3, figs. 2, 2a-b
- 2001 *Clypeaster* cf. *laganoides* AGASSIZ, 1847 – MIKUŽ & MITROVIĆ-PETROVIĆ: 56-57; pl. 4, figs. 1, 1a
- 2001 *Clypeaster* cf. *scutellatus* SERRES – MIKUŽ & MITROVIĆ-PETROVIĆ: 57-58; pl. 5, figs. 2, 2a
- 2001 *Clypeaster balillai* (LOVISATO, 1911) – MIKUŽ & MITROVIĆ-PETROVIĆ: 58-60; pl. 4, fig. 2; pl. 6, figs. 2, 2a-b
- 2001 *Clypeaster* cf. *balillai* (LOVISATO, 1911) – MIKUŽ & MITROVIĆ-PETROVIĆ: 60-61; pl. 6, figs. 1, 1a
- 2002 *Clypeaster subfolium* – KAZÁR: 153; fig. 1

#### Type-material:

Holotype: the specimen figured by MICHELIN (1861: 139; pl. 20, figs. 2a-d); Museum of Genève, Deluc collection (according to LAMBERT, 1912: 121 and LAMBERT & JEANNET, 1928)

Locus typicus: Palermo, Sicily, Italy

Age: Miocene

#### Material:

Early Badenian (Langhian) – Stotzing (sandpit Mayer), Bgld, Austria

NHMW: 4 specimens (NHMW 2004z0093/0019-21, 2005z0007/0001)

Wanzenböck coll.: numerous specimens (others without inventory numbers)

#### Foreign material for comparison:

Early Badenian (Langhian) – Mátraverebély, Nograd, Hungary

MAFI: 1 specimen [MAFI Ech 434 (material referred to as *Clypeaster subfolium* POM. by VADÁSZ, 1915: 196-197)]

Late Badenian (Early Serravallian) – Gârbova de Sus (= Felső-Orbó), Romania

MAFI: 4 specimens [MAFI Ech 317, 318, 319, 320 (material referred to as *Clypeaster subfolium* POM. by VADÁSZ, 1915: 196-197; fig. 86-88)]

#### Dimensions (in mm):

Inv. no.	TL	TW	TH	remarks
W22	99.6	91.0	19.4	
NHMW 2004z0093/0020	97.1	92.6	18.3	
NHMW 2004z0093/0019	53.5	49.3	10.8	deformed
NHMW 2004z0093/0021	94.5	80.3	-	deformed

#### Description

Size and shape: The test is of medium to large size with antero-posteriorly elongated, irregularly subpentagonal outline. There are characteristic marginal indentations in the interambulacra, especially in interambulacra 1, 4 and 5. These indentations can be very strongly developed (e.g. Pl. 27, Figs. 2a-b) but may also be less prominent. The margin of the test is thin, with a rounded profile anterior and a sharp profile posterior. The maximum width lies anterior of the centre, where ambulacral columns IIa and IVb reach the ambitus. In profile, the test is very low with a moderately raised petaloid area. The apex coincides with the apical disc. The oral surface is flattened with deep food grooves and a moderately deep, broad infundibulum.

Apical disc: The apical disc lies subcentrally, varying from a slightly posterior to a slightly anteriorly displaced position (rarely exceeding 3% TL displacement). It is monobasal with a large central, subpentagonal madreporite and 5 circular gonopores.

Ambulacra: All five ambulacra are distinctly petaloid. The petals are straight, broad and relatively short, extending about 44 to 48 % of the corresponding test radius. The frontal petal is the longest; the posterior paired petals are shortest (but difference between APP and PPP is usually slight). The poriferous

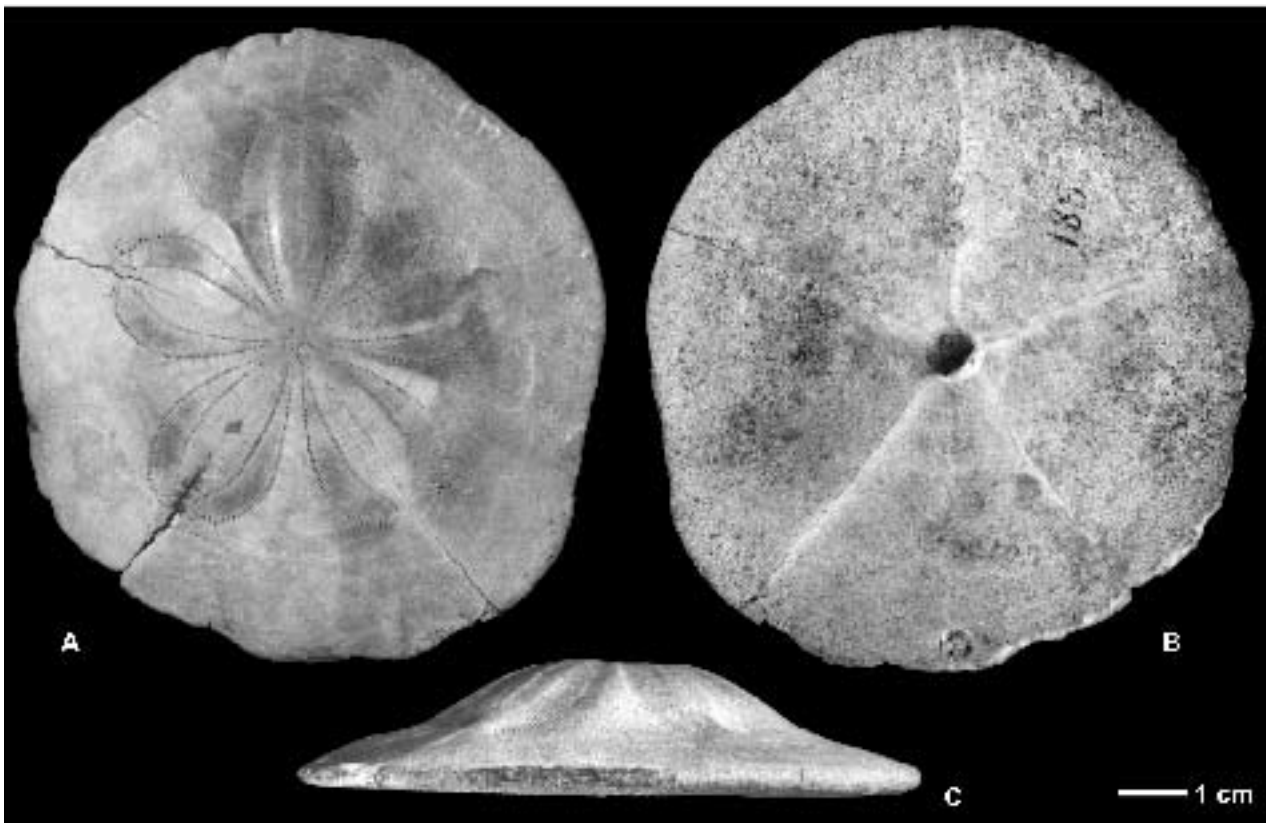


Figure 29: *Clypeaster latirostris* MICHELIN, 1861: lectotype (Burdigalian ? of Corsica; NHMW 1860.XIX.6).

zones are slightly depressed and moderately wide. The pore pairs are conjugated anisopores. Adjacent pore pairs are separated by a narrow ridge with a single row of up to 6 primary tubercles. The interporiferous zones are moderately inflated and usually 2.6 to 2.8 times as wide as a single poriferous zone at the widest point of the petals. They are crowded with primary tubercles similar to those on the interambulacra. On the oral surface deep, simple unbranched food grooves are present in the axis of the ambulacra.

**Interambulacra:** The interambulacra are slightly inflated adapically between the petals. They are crowded with very small perforate crenulate primary tubercles in sunken areoles. Between the primary tubercles, dense miliary tuberculation is present. Tubercle density and size is rather homogenous on the aboral surface. On the oral surface tubercles are much larger (about twice as large). The interambulacra are slightly flattened on the oral surface, producing an even surface, except adorally, where they are inclined towards the peristome.

**Peristome:** The peristome is circular and lies centrally on the oral side of the test in a wide, moderately deep infundibulum with gently sloping walls.

**Periproct:** The periproct is subcircular and lies inframarginally, about 3 mm away from the posterior margin.

**Internal support system:** The test of this species is single-walled but reinforced by a dense internal pillar system especially in the marginal, thinner parts of the corona.

#### Differential diagnosis:

For the difference to *C. barcinensis* ? LAMBERT, 1906 see above under that species.

*C. calabrus* SEGUENZA, 1880, a species occurring in the Badenian (Langhian – Early Serravallian) in the Paratethys, differs from *C. folium* by its higher test, with more strongly raised petaloid area, thicker margin, deeper infundibulum and more strongly inflated interporiferous zones.

*C. campanulatus* (SCHLOTHEIM, 1820) (and its phenotypes), a species occurring in the Badenian (Langhian – Early Serravallian) of the Paratethys, differs by its strongly different profile, larger test height, broader and longer petals, more strongly raised petaloid area and thicker margin.

*C. intermedius* DES MOULINS, 1837, an Early Miocene species of the Rhône Basin, differs from *C. folium* by its higher test, lack of prominent marginal indentations in the interambulacra, much larger and more raised petaloid area, and its deeper infundibulum.

For the difference to *C. latirostris* MICHELIN, 1861 see below under that species.

For the difference to *C. neudorfensis* LAMBERT, 1927 see below under that species.

For the difference to *C. scillae* DES MOULINS, 1837 see below under that species.

*C. marginatus* LESKE, 1778, from the Early Miocene of western France differs by its larger petalodium, more strongly inflat interporiferous zones, more elongated petals and narrower infundibulum. The Late Miocene Maltese species, which has often been confused with *C. marginatus* [compare LAMBERT (1927b: 98-101)] differs by its pentagonal outline, much narrower posterior end, thinner margin, narrower infundibulum (interambulacra not gently sloping to the peristome), smaller petalodium and more strongly raised petaloid area, and large dish-like marginal area.

#### Discussion:

According to LAMBERT & JEANNET (1928: 179) this species is synonymous to *C. scutellatus* DE SERRES. Furthermore, they place *C. lovisatoi* COTTEAU (non SEGUENZA) into the synonymy of *C. scutellatus* [not, however, *C. martini*, tentatively placed into the synonymy of *C. folium* by DESOR (1858: 243)]. On basis of the description in DE SERRES (1829: 157) I am, however, not able to validate this statement and therefore continue to use the name